



OLLSCOIL NA GAILLIMHE
UNIVERSITY OF GALWAY

Autumn Examinations 2022-2023

Course Instance Code(s)	4BCT1, 4BS2
Exam(s)	Fourth B.Sc. Computer Science and IT Fourth B.Sc. Science
Module Code(s)	CT421
Module(s)	Artificial Intelligence
Paper No.	1
External Examiner(s)	Dr. R. Trestian
Internal Examiner(s)	Professor M. Madden *Dr. C. O'Riordan

Instructions: Answer any 3 questions. All questions are equally weighted.

Duration	2 hours
No. of Pages	3
Discipline(s)	Computer Science
Course Co-ordinator(s)	Dr. C. O'Riordan

Requirements:

Release in Exam Venue	Yes
Handout	None
Statistical/ Log Tables	None
Cambridge Tables	None
Graph Paper	None
Log Graph Paper	None
Other Materials	None

PTO

CT421 Artificial Intelligence

Q.1.

- (a) Draw a search tree with breadth 3 and depth two. Label each node and show the order the nodes are visited for each of the following traversals:
- i) Breadth first search
 - ii) Depth first search
 - iii) Iterative Deepening. (6)
- (b) With respect to the game of *tic-tac-toe* (*noughts and crosses*), sketch a game tree for the first two moves. Given a complete game tree, show with examples how the *minimax algorithm* can be applied to choose suitable moves to play the game. (9)
- (c) For two player games like *tic-tac-toe* and *connect-four*, minimax can be adopted. Outline briefly difficulties that arise when three-player games are involved. (5)
- (d) Explain what is meant by a heuristic and why they are used in many search algorithms. For *tic-tac-toe*, outline suitable heuristics for the game. (5)

Q.2.

- (a) With reference to Genetic Algorithms and the schema theorem, explain the effects on a population of solutions of:
- a) Mutation
 - b) Crossover
 - c) Selection (11)
- (b) With reference to the travelling salesperson problem involving N cities with a set of values representing the distances between all pairs of cities, describe how you might use a genetic algorithm to attempt to solve the problem. Describe the following: your solution representation, a suitable fitness function, a selection approach and suitable genetic operators. (14)

Q.3.

- (a) Auction protocols have been adopted in the multi-agent system community as a means to allow agents find an agreement suitable to all parties. Compare the English auction protocol with the Dutch auction protocol. Your answer should include:
- i) A description of the protocol involved
 - ii) An explanation of the rational strategy for the bidders
 - iii) Any potential limitations of the protocol.
- (9)
- (b) Auctions have been used to allow agents to agree on a price. Suggest an efficient approach that would allow agents to negotiate with the aim of finding points of agreement on a number of attributes in addition to price. (8)
- (c) Game theory has been used in a number of domains to model and reason about strategic decision making. With respect to game theory, and using a payoff matrix, explain the following concepts: a dominant strategy, Nash equilibrium. (8)

Q.4.

- (a) Explain briefly the importance of *explainability* in artificial intelligence. With reference to an AI paradigm of your choice, outline approaches that have been taken towards building AI systems that can generate explanations. (8)
- (b) Describe, in your own words, what is meant by neuro-evolution. Describe a suitable means to represent a neural network for a neuro-evolution system. (9)
- (c) Novelty search represents an alternative approach to search. Describe, with reference to a problem domain of your choice, the main concepts in novelty search. (8)

End